

## **Effects of the lattice orientation and the interface termination on negative refraction in 2D photonic crystals**

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Negative refraction at the interface between air and a 2D square photonic crystal (PhC) at frequencies corresponding to the second band is analysed by means of equifrequency contour (EFC) diagrams and FDTD simulations. Several lattice orientations inside the slab giving rise to different slab terminations are considered to observe the influence of the lattice and the termination over the EM propagation. In principle, from the EFC analysis it could be established that if the EFC has a rounded shape and its radius decreases with frequency, the PhC should behave as a refractive medium with a negative effective index. However, we find that these conditions are not sufficient for the PhC to behave as a negative refractive medium. EM propagation inside the PhC is highly sensitive to the lattice orientation and the interface periodicity. It can be stated that a negative refractionlike behavior can only be observed when the interface is periodic and the mode symmetries of the external plane wave and the Bloch wave inside the PhC are matched. Even under this assumption, the Snell's law is not satisfied if the interface is not properly selected because the EFC retains a slight square-like shape even for frequencies near the bandgap. In addition, when the Snell's law is met the Goos-Hänchen effect for a finite slab has to be considered to obtain the effective index of refraction.